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COMPLETE SPECIFICATION
FOR A STANDARD PATENT

Name of Applicant	EQUIVALENT COOLING TOWERS CO PTY LTD
Actual Inventor	Ronald William Lewis
Address for Service:	CULLEN & CO., Patent & Trade Mark Attorneys, 240 Queen Street, Brisbane, Qld. 4000, Australia.
Invention Title:	GRID PANEL AND FILL SYSTEM FOR COOLING TOWERS

The following statement is a full description of this invention, including the best method of performing it known to us:

This application is a further application under Section 39 of the Patents Act 1990 in respect of an invention disclosed in the specification of Australian patent application no. 14958/95.

This invention relates to an improved fill system for cooling towers and, in particular, to the grid panels used in that fill system.

BACKGROUND ART

Industrial evaporative water cooling towers of the crossflow type are normally provided with a splash fill structure comprising an array of horizontally extending slats or bars. Hot water, required to be cooled, is primarily in the form of drops or small streams which are discharged from a distribution system overlying the fill structure, and fall onto and directly impact the upper faces of the splash bars. When the hot water drops hit the splash bars, they are further dispersed into smaller droplets. Since the smaller droplets have a higher surface area to volume ratio, they are able to dissipate heat faster.

Simultaneously, cooling air is drawn in from outside in a generally horizontal direction and is passed through the fill structure, either by means of motor driven fans or through use of a natural draft-inducing hyperbolic tower. Interactive thermal exchange occurs between the cooling air and the descending water droplets, before the latter are ultimately collected in a cold water basin underlying the fill structure.

Splash bars of a crossflow cooling tower should remain in a straight horizontal orientation for optimum performance. If the bars sag, uniform hot water and cooling air distribution throughout the fill structure is disrupted and the effectiveness of the tower will be impaired. To avoid this problem, the fill structure may include upright grids with horizontal supporting members for the splash bars, spaced at centres small enough to prevent the splash bars from sagging under normal

conditions.

Various clips and fastening devices are used to hold the splash bars in position on the supporting members. An example of one such clip can be found in U.S. patent no. 4,774,034.

Due to the constant bombardment of the splash bars by water droplets, the wet heated environment, and the high air flow, the splash bars degrade relatively quickly and have a limited working life. Replacement of the splash bars is a tedious and time consuming process, as each bar must be unfastened and refastened individually to the supporting grid.

Another problem encountered with splash bars is that, due to vibration of the support grid and other factors, the splash bars can work loose or otherwise be dislodged from their design positions, thereby reducing cooling efficiency.

Grid-like panels have been used in order to overcome the disadvantages of splash bars. Such panels are in the form of square fill grids which are arranged in vertically spaced layers. The grid panels are typically made of moulded plastics material. One such splash fill system is the OPTI-GRID™ system produced by Tower Components, Inc. Each fill grid panel is supported at four points from vertically extending suspension wires, using individual fasteners.

However, the known fill grids have several disadvantages. For example, since the grids are supported at spaced points, they tend to sag in the middle over time. Furthermore, the suspension wires must be positioned at precise locations. This can cause problems in design when there are obstructing columns or girts. Systems designed for a metric based spacing would not be suitable for an imperial based spacing. Thirdly, the method of fastening the grids to the suspension wires is relatively complex and tedious. Finally, the grids are difficult to remove and replace.

It is an object of the present invention to

provide an improved grid panel for use in a fill system for a cooling tower.

It is a further object of this invention to provide an improved fill system.

SUMMARY OF THE INVENTION

In one broad form, the present invention provides a panel suitable for use in a fill system for a water cooling tower, the panel being generally rectangular overall with a length about twice its width. The panel has a grid-like form, and is adapted to be supported, in use, at its sides in a horizontal orientation.

The panel preferably has a pair of spaced reinforcement portions extending along its length for strengthening purposes. Each reinforcement portion is suitably a rib formation located inwardly from each longer edge of the panel. More preferably, each rib formation is a double rib.

Typically, the panel is made of thermoplastics material, such as polypropylene, by moulding, e.g. injection moulding.

In another form, the invention provides a fill system suitable for use in a cooling tower, comprising

a plurality of spaced parallel rails, and

a plurality of grid panels slidably mounted between adjacent rails and supported thereon, the grid panels being generally rectangular in shape with a length about twice the width.

The rails extend substantially horizontally, and preferably have an I-shaped cross section comprising a central web and top and bottom flanges. A side edge of each grid panel is located between the top and bottom flanges of a rail. The side edge is supported on the bottom flange of the rail, while the top and/or bottom flange(s) ensure(s) that the panel is securely retained on the rail.

The rails are spaced apart horizontally by a distance equal to the width or length of the panels, with

added allowance for tolerances. The space between a pair of rails can be filled simply by inserting the grid panels between the ends of the rails, and sliding the panels along the rails until the space is completely filled by abutting panels. This procedure is repeated for all rails at that particular level to form a complete layer of panels.

Typically, sets of rails are suspended in vertically spaced rows so that the completed fill system comprises several layers of panels.

Preferably, the rails are suspended from suspension wires. The rails have a double-walled web portion, and the suspension wires pass through the web, between its walls. Apertures are suitably bored in the top and bottom portions of the rail at the positions of the suspension wires.

Preferably, the rails are spaced apart by tubular spacers which are threaded onto the suspension wires between vertically adjacent pairs of rails.

In order that the invention may be more fully understood and put into practice, a preferred embodiment thereof will now be described, by way of example only, with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of a fill system according to one embodiment of the invention,

Fig. 2 is a fragmentary perspective view of part of the fill system of Fig. 1,

Fig. 3 is a fragmentary plan view of a fill grid layer of Fig. 1,

Fig. 4 is a plan view of a fill grid of Fig. 1,

Fig. 5 is a sectional elevational view along A-A of the fill grid of Fig. 4,

Fig. 6 is a sectional elevational view along B-B of the fill grid of Fig. 4, and

Fig. 7 is a sectional view of a rail with mounted fill grid of Fig. 1.

DESCRIPTION OF PREFERRED EMBODIMENT

As shown in Fig. 1, a fill system 10 comprises several layers of grid panels or "fill grids" 11. Each fill grid 11 is located between an adjacent pair of spaced rails 12, and is supported along its side edges by the respective rails 12.

The rails 12 are suspended at vertically spaced locations by suspension wires 13 which pass through the rails at spaced intervals. The suspension wires 13 depend from longitudinal girts 14 which are supported by transverse girts 15 extending between columns 16. The girts 14, 15 and columns 16 form the structural frame of the fill system.

As shown in enlarged detail in Fig. 2, the rails 12 are generally of "I" shaped cross section. The side edges of each fill grid 11 are received between the top and bottom flanges of each rail. A layer of fill grids can be formed by inserting the grids between adjacent rails 12 at that particular level, and sliding the fill grids 11 along the rails 12 to the desired position. The side edges of the fill grids 11 are supported by the bottom flanges of the rails 12, and retained thereon with the assistance of the top flanges of the rails.

As shown in Fig. 3, the rails 12 are spaced apart by a distance slightly greater than the length of the grids 11. Alternatively, the rails 12 can be spaced apart by a distance slightly greater than the width of the fill grids 11 so that certain fill grids 11A can be introduced longitudinally between the rails, rather than transversely. Thus, the layout of the rails can be selected to suit the particular configuration of the tower or structural frame, and thereby maximise site coverage.

A fill grid 11 is shown in more detail in Fig. 4. The fill grid 11 is typically formed from plastics material, such as polypropylene, by injection moulding. Each fill grid 11 is of foraminous or cribriform appearance, and is formed by a honeycomb grid with a

generally rectangular shape overall. As shown in the drawings, the generally rectangular panel is about twice as long as it is wide. That is, its longest dimension is about twice the transverse dimension.

Also as shown in Figs. 4-6, the panel 11 has a pair of reinforcement portions in the form double ribs 11b running along its length for stiffening purposes, as well as additional strengthening ribs in the pattern shown in dashed outline in Fig. 4. Each double rib is spaced inwardly from a respective longitudinal boundary of the panel. In this manner, if part of the edge portion of the panel has to be removed to accommodate a post or other obstacle, the structural strength of the fill grid is not substantially reduced.

Each fill grid 11 has straight edges 18 along its shorter sides. These edges have integrally moulded upper and lower lip formations 20, 19, as shown in Fig. 5. The longer side edges of the grid illustrated in Fig. 4 are stepped since they follow the honeycomb pattern, but could be made straight if desired. The outer step portions 18A along the longer side edge of the fill grid 11A are also provided with upper and lower integrally moulded lip portions 20A, 19A as shown in Fig. 6.

The rail 11 is shown in greater detail in Fig. 7. The rail 11 comprises a double wall web 21 extending between upper and lower flanges 22, 24. The upper flange 22 extends on either side of the web 21, and is provided with a downwardly turned outer edge which forms an inverted lip 23.

The bottom flange 24 also extends on either side of the web 21, and is provided with an upturned outer edge on each side, which forms a lip 25. For added strength, the bottom flange 24 may be of box section design incorporating a buttressing portion 26.

Wherever it is desired that a suspension wire passes through the rail 11, apertures are made in the top flange 22 and (double) bottom flange 24, along the centre line of the rail, i.e. between the double walls of the web

21. Indentations are suitably provided in the upper and lower flanges to facilitate centering of the drill used to make the apertures.

In use, suspension wires 13 are passed through the rails 11 at spaced locations therealong, the suspension wires passing between the double walls of each rail web 21. A clamp (not shown) may be fixed to each suspension wire 13 below the rails 11 to support the rails and enable them to be suspended at the desired height by the suspension wires 13. Tubular spacers 17 are threaded onto the suspension wires 13, and are positioned between vertically adjacent rails so as to space the rails apart in the vertical direction.

Once the array of rails 11 has been formed, the fill grids 11 are mounted to the rails. Most fill grids are mounted by slidably inserting the side edges 18 of a fill grid 12 between the top and bottom flanges 22, 24 of a respective one of a pair of adjacent rails 11. As shown in Fig. 7, the side edges 18 of the grids 11 are captively received between the top and bottom flanges of the rail. The lips 23, 25 on the top and bottom flanges 22, 24 abut against the upper and lower lip portions 20, 19 of the side edge 18 and prevent the grid 12 from being pulled out transversely from the rail 11. Yet, each grid is free to slide along the rail 11, between its upper and lower flanges on one side thereof. Since the suspension wires 13 pass inside the web 21, they do not obstruct the free travel of the grids 12 along the rails 11.

The upper lip 20 on side edge 18 is deliberately made small. Due to the inherent resilient nature of the upper flange 22, the side edge 18 can be snapped into engagement with the rail 11 from the side. Similarly a grid can be levered out of engagement with the rail from the side.

In the event that it is necessary to change one grid in a row, that grid can be individually removed from engagement with its adjacent rails, i.e. without having to remove all the grids between the grid and the end of the

rails. A replacement grid can be snapped into engagement with the rails at that position or alternatively, the remaining grids can be pushed along the rails to fill the space occupied by the removed grid, and the replacement grid can be inserted at the end of the rails.

The abovedescribed fill grids have several advantages, including:

(i) The fill grids are stronger than known grids through use of a more advantageous length:width ratio.

(ii) The recessed centre section of each fill grid suits towers with imperially spaced columns without adjustment, and recovers part of the uncovered area on both sides of the column. Adjustment for all other cases can be achieved without reducing the structural strength of the fill grid or the fill system.

(iii) The rectangular shape of each fill grid and its unique edge design on the four sides of the grid allows it to be used in "narrow runs" inside cooling towers.

(iv) The fill grids are self aligning in longitudinal and transverse directions.

(v) The fill grids can be secured in place without any additional clips or fasteners.

(vi) Servicing and cleaning of cooling towers is facilitated.

The abovedescribed fill system has several advantages, including:

(i) The positions of the suspension wires 13 are not critical, i.e. the wires can be spaced at various positions along the rails. Thus, the positioning of the suspension wires can be chosen to suit the particular support structure, or to accommodate any existing structure.

(ii) The fill grids can be inserted quickly and simply, by sliding along the rails.

(iii) The fill grids are supported along two sides, and not merely at four points.

(iv) The fill spacers support the rails against torsion by extending the support provided by the rigid

structural frame along the suspension wires.

(v) The grids can be orientated longitudinally or transversely.

(vi) Although the grids are normally inserted at the ends of the rail, they can be mounted onto the rails at any position therealong.

(vii) The rails are automatically spaced along the suspension wires by the tubular fill spacers.

(viii) The positioning of the rails and grids can accommodate intervening structural members such as columns and braces.

(ix) The fill system is able to provide more efficient site coverage.

The foregoing describes only embodiment of the invention, and modifications which are obvious to those skilled in the art may be made thereto without departing from the scope of the invention as defined in the following claims. For example, the fill grids of this invention can be used in a counterflow cooling tower and not just a crossflow tower.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A panel suitable for use in a fill system for a water cooling tower, the panel being generally rectangular overall with a length about twice its width, and being of grid-like form, the panel being adapted to be supported, in use, at its sides in a horizontal orientation.

2. A panel as claimed in claim 1 wherein the panel has a pair of spaced reinforcement portions extending along its length.

3. A panel as claimed in claim 2, wherein each reinforcement portion is a double rib extending longitudinally, each double rib being spaced inwardly of a respective longitudinal boundary of the panel.

4. A panel as claimed in any preceding claim, wherein the panel is made from thermoplastics material.

5. A fill system for a cooling tower, comprising

a plurality of spaced parallel rails, and

a plurality of grid panels as claimed in any preceding claim, the panels being slidably mounted between adjacent rails and supported thereon.

6. A fill system as claimed in claim 5, wherein the rails are generally of I-shaped section, comprising a substantially upright web portion and top and bottom flanges extending substantially horizontally from the web portion.

7. A fill system as claimed in claim 6, wherein each rail has a closed section reinforcement portion below its bottom flange.

8. A fill system as claimed in claim 6 or 7, wherein the rails are extrusions of plastics material.

9. A fill system as claimed in any one of claims 6 to 8, wherein the grid panels are supported at a pair of opposite side edges thereof, each of the pair of side edges being supported on the bottom flange of a respective rail and retained thereon by the top flange of that rail.

10. A fill system as claimed in claim 9, wherein the top and bottom flanges of each rail have lip formations at their free edges orientated towards each other, the edge

of the rail being held between the lip formations.

11. A fill system as claimed in any one of claims 5 to 10, wherein the rails are suspended in vertically spaced layers to form a three dimensional array of parallel rails.

12. A fill system as claimed in claim 11, further comprising a frame structure and suspension wires dependent from horizontal members of the frame structure, the rails being suspended by the wires.

13. A fill system as claimed in claim 12, wherein each rail has a double-walled central web portion, the wires passing through the web portion between its walls.

14. A fill system as claimed in claim 12 or 13, further comprising tubular spacer members threaded onto the suspension wires between vertically adjacent pairs of rails.

15. A fill system as claimed in any one of claims 5 to 14, wherein the grid panels have a honeycombe pattern of apertures therein.

16. A fill structure for a cooling tower, comprising a three-dimensional array of parallel rail members, and a plurality of panels as claimed in any one of claims 1 to 4, the panels being slidably mounted on adjacent rails and having an opposite pair of their edges supported by the adjacent rails.

17. A fill system substantially as hereinbefore described with reference to the accompanying drawings.

18. A panel for a fill system, the panel being substantially as hereinbefore described with reference to Figs. 4 to 6 of the accompanying drawings.

Dated this third day of June 1999
EQUIVALENT COOLING TOWERS CO. PTY. LTD.
By their Patent Attorneys
CULLEN & CO.

ABSTRACT

A fill grid (11) for a fill system (10) for a cooling tower is in the form of a generally rectangular panel having a length about twice its width. The panel is of grid-like form, and has a pair of double ribs (11b) extending along its length. The fill system (10) has a three-dimensional array of spaced parallel rails (12). The rails (12) are suspended by wires (13) depending from girts (14) which form part of the structural frame of the fill system. Each rail (12) is generally of I-section with upper and lower flanges (22, 24). The panels (11) are slidably inserted between adjacent pairs of rails, the opposite edges of the panels (11) being supported on the lower flanges (24) of the adjacent rails (12) and retained thereon by lips (23, 25) formed on the flanges (22, 24).

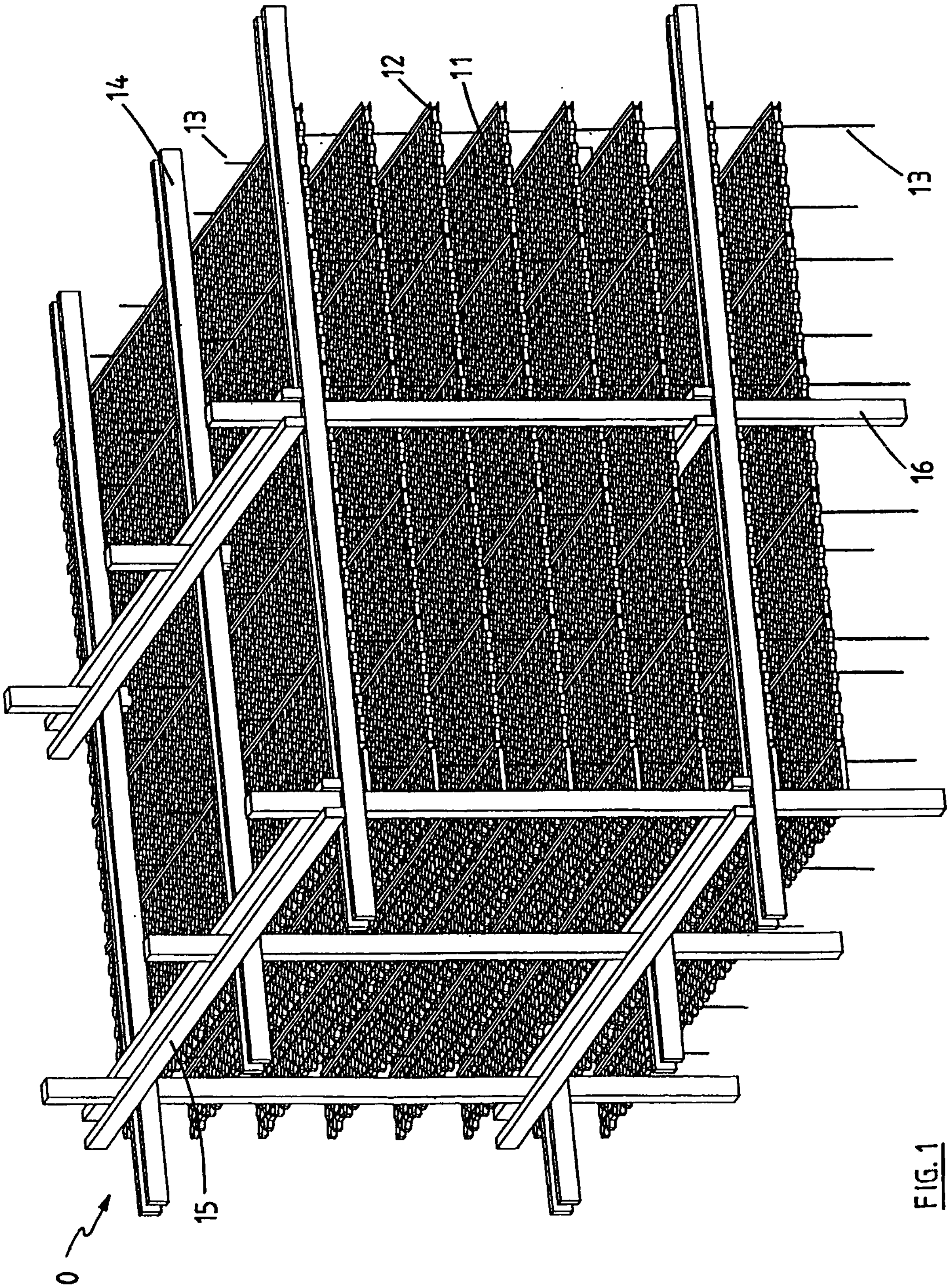

FIG.1

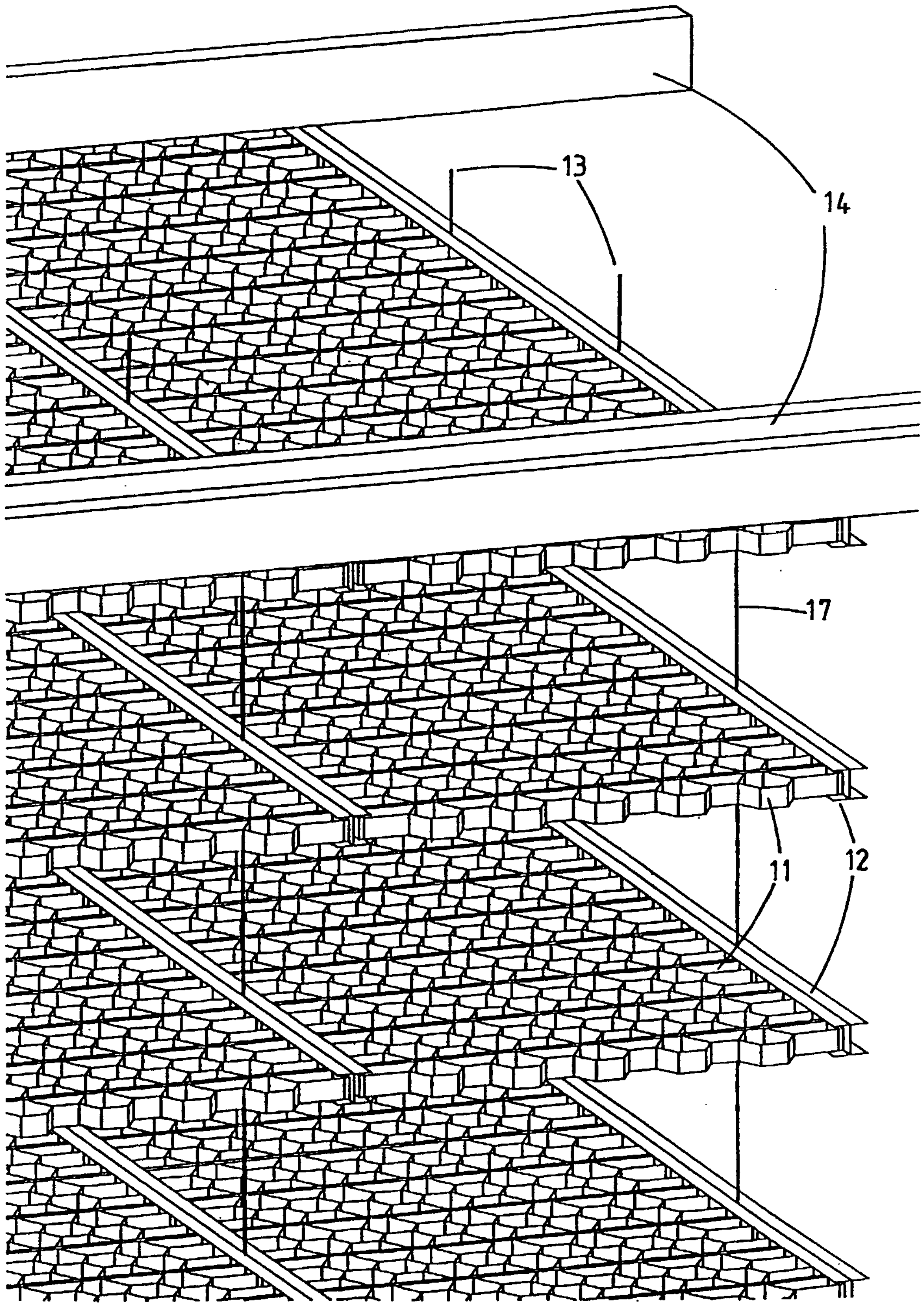

FIG. 2

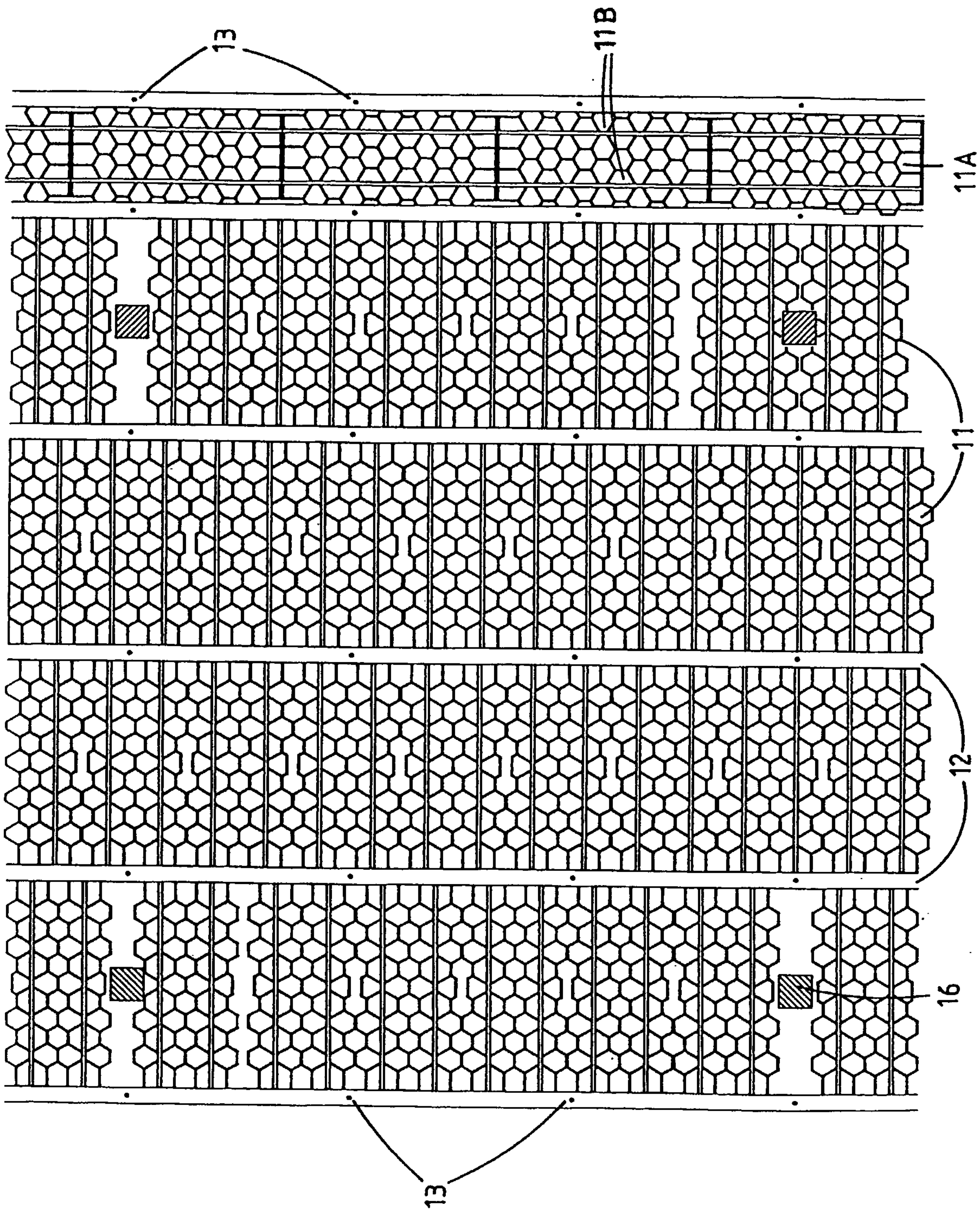

FIG.3

03 06 99 33145

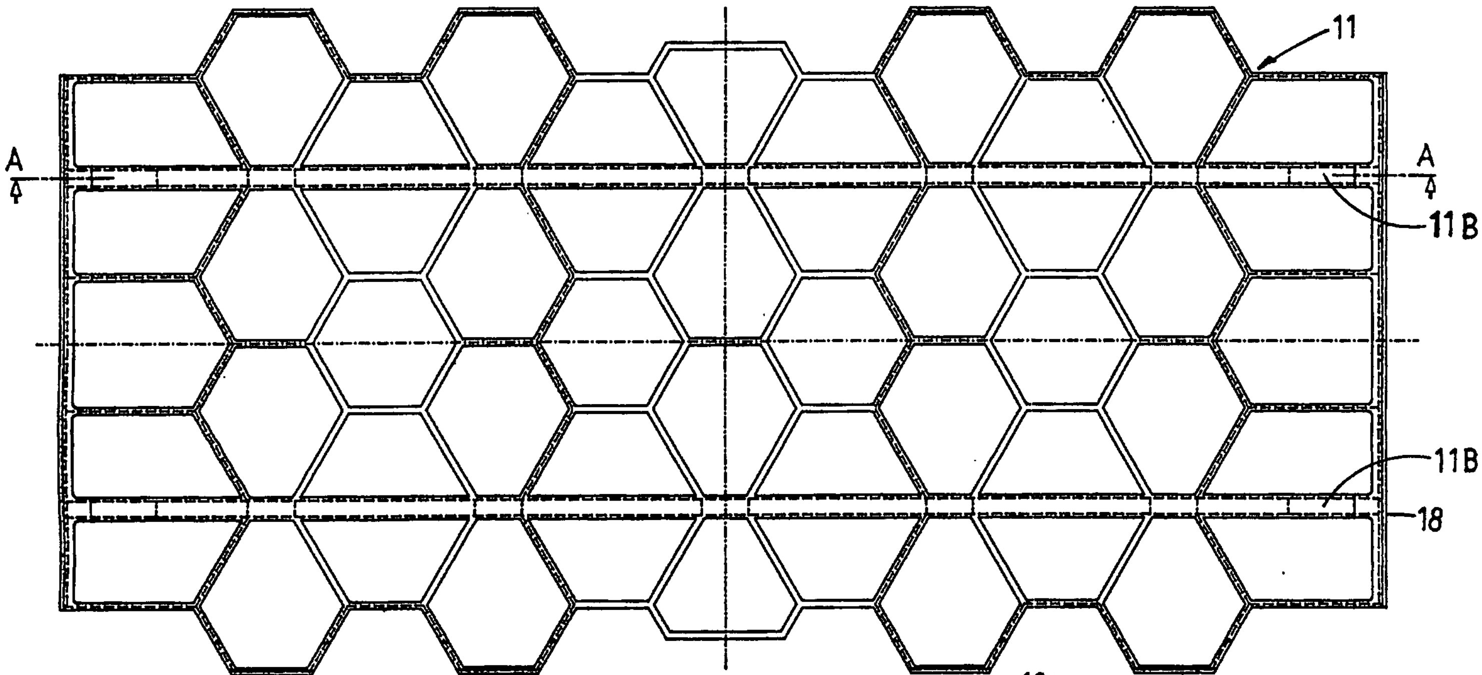

FIG. 4

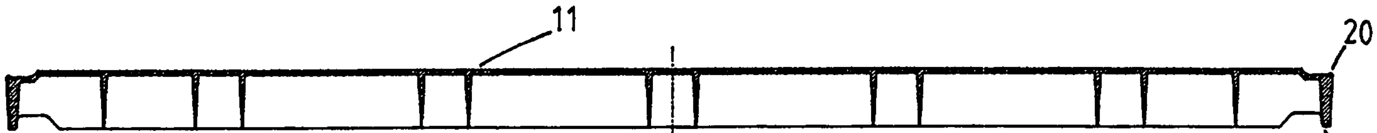

FIG. 5

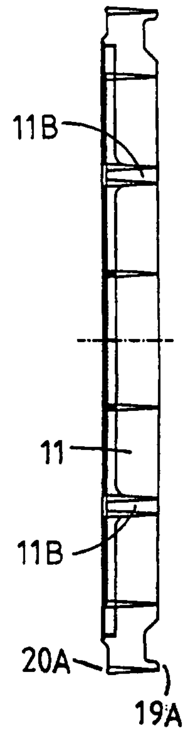

FIG. 6

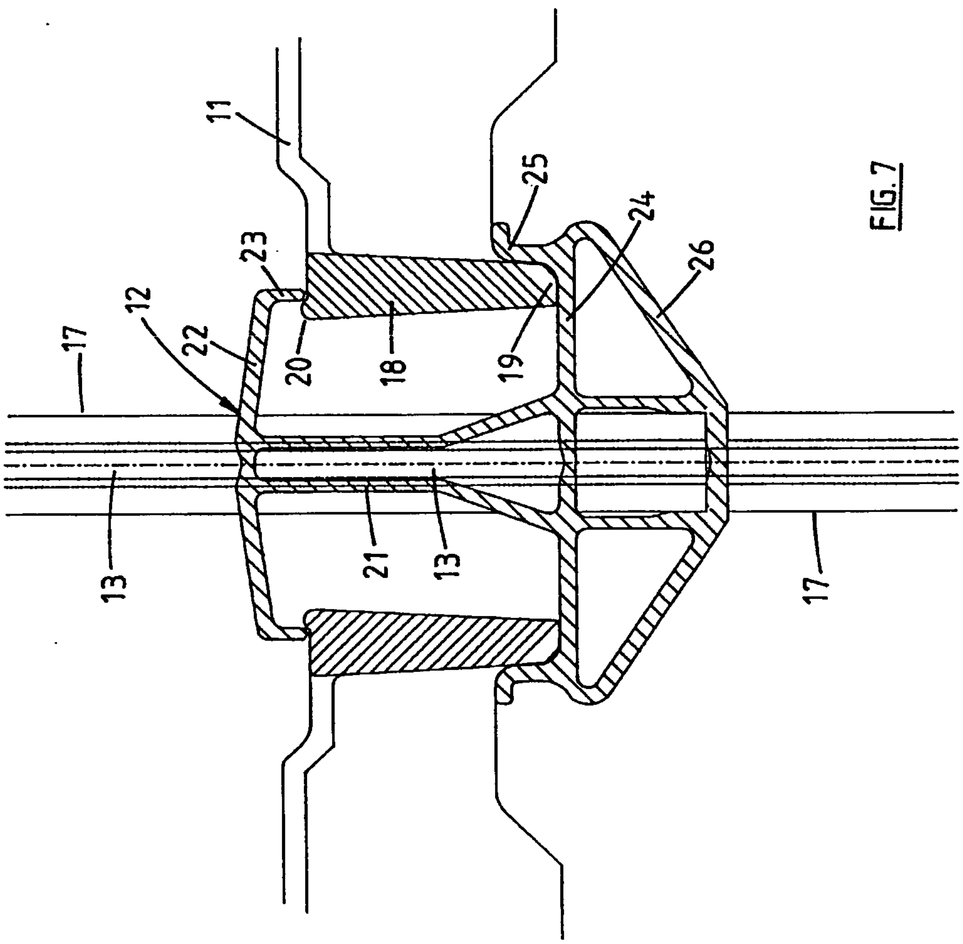

FIG. 7